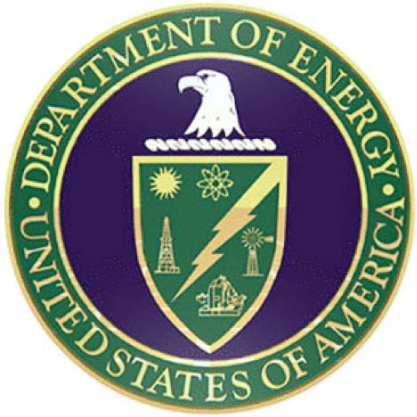

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Environmental Remediation Science Program at the National Laboratories

U.S. Department of Energy
Office of Science
Office of Biological & Environmental Research

ERSP PI Meeting

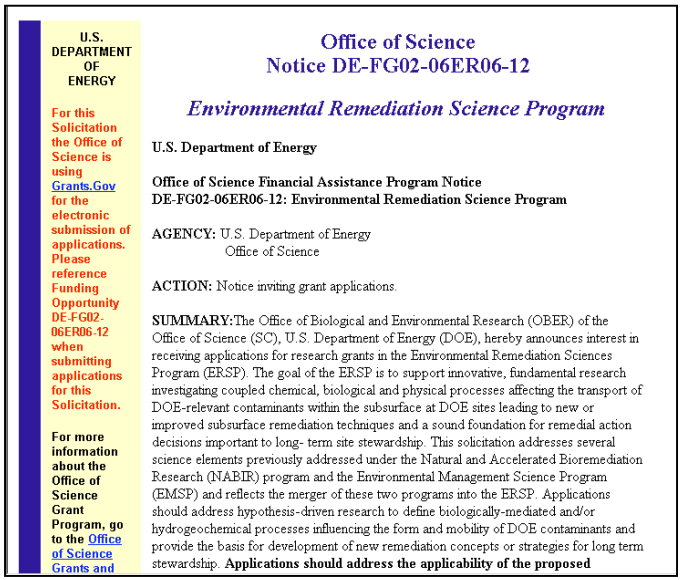
April 9, 2008

U.S. Department of Energy
Office of Science

BER Funding of Research at The National Laboratories

Historical Perspective (last ~10 years)

- BER issued targeted solicitations to National Laboratory investigators.
  - very similar to solicitations directed towards Academic investigators.
  - In the recent past the ERSP issued two concurrent solicitations per year.



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For this Solicitation the Office of Science is using Grants.Gov for the electronic submission of applications. Please reference Funding Opportunity DE-FG02-06ER06-12 when submitting applications for this Solicitation.

For more information about the Office of Science Grant Program, go to the Office of Science Grants and

Office of Science
Notice DE-FG02-06ER06-12

Environmental Remediation Science Program

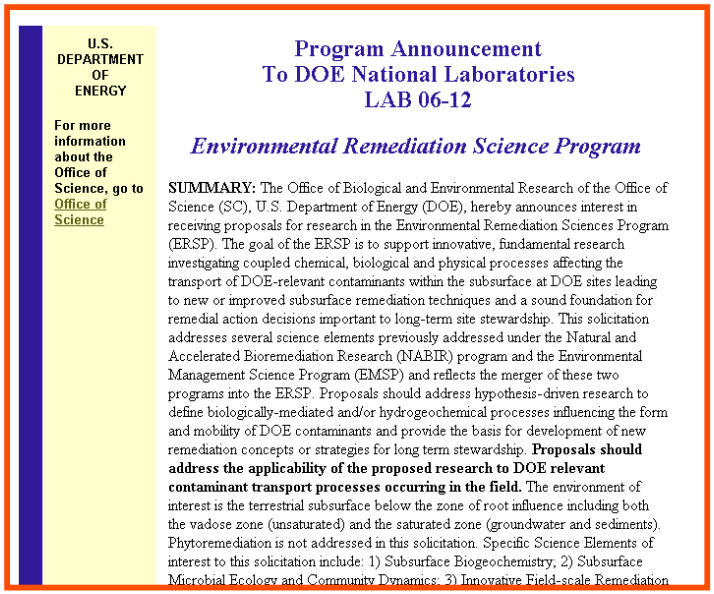
U.S. Department of Energy

Office of Science Financial Assistance Program Notice
DE-FG02-06ER06-12: Environmental Remediation Science Program

AGENCY: U.S. Department of Energy
Office of Science

ACTION: Notice inviting grant applications.

SUMMARY: The Office of Biological and Environmental Research (OBER) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces interest in receiving applications for research grants in the Environmental Remediation Sciences Program (ERSP). The goal of the ERSP is to support innovative, fundamental research investigating coupled chemical, biological and physical processes affecting the transport of DOE-relevant contaminants within the subsurface at DOE sites leading to new or improved subsurface remediation techniques and a sound foundation for remedial action decisions important to long- term site stewardship. This solicitation addresses several science elements previously addressed under the Natural and Accelerated Bioremediation Research (NABIR) program and the Environmental Management Science Program (EMSP) and reflects the merger of these two programs into the ERSP. Applications should address hypothesis-driven research to define biologically-mediated and/or hydrogeochemical processes influencing the form and mobility of DOE contaminants and provide the basis for development of new remediation concepts or strategies for long term stewardship. **Applications should address the applicability of the proposed**



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For more information about the Office of Science, go to Office of Science

Program Announcement
To DOE National Laboratories
LAB 06-12

Environmental Remediation Science Program

SUMMARY: The Office of Biological and Environmental Research of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces interest in receiving proposals for research in the Environmental Remediation Sciences Program (ERSP). The goal of the ERSP is to support innovative, fundamental research investigating coupled chemical, biological and physical processes affecting the transport of DOE-relevant contaminants within the subsurface at DOE sites leading to new or improved subsurface remediation techniques and a sound foundation for remedial action decisions important to long-term site stewardship. This solicitation addresses several science elements previously addressed under the Natural and Accelerated Bioremediation Research (NABIR) program and the Environmental Management Science Program (EMSP) and reflects the merger of these two programs into the ERSP. Proposals should address hypothesis-driven research to define biologically-mediated and/or hydrogeochemical processes influencing the form and mobility of DOE contaminants and provide the basis for development of new remediation concepts or strategies for long term stewardship. **Proposals should address the applicability of the proposed research to DOE relevant contaminant transport processes occurring in the field.** The environment of interest is the terrestrial subsurface below the zone of root influence including both the vadose zone (unsaturated) and the saturated zone (groundwater and sediments). Phytoremediation is not addressed in this solicitation. Specific Science Elements of interest to this solicitation include: 1) Subsurface Biogeochemistry; 2) Subsurface Microbial Ecology and Community Dynamics; 3) Innovative Field-scale Remediation

- The targeted approach by BER programs for the Labs is different than the overall approach used by other major funding offices within DOE's Office of Science.

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A New Approach for BER Funding at The National Laboratories

Current Funding to the National Laboratories

- Large collections of single PI projects, sometimes disparate, at the Labs is not effective use of the National Laboratory system.
- Does not take full advantage of the unique capabilities, strategic focus, flexibility and administrative resources at the Labs.
- Does not take advantage of the National Laboratories' ability to conduct coordinated interdisciplinary and multidisciplinary research.

Restructuring of BER Funding to the National Laboratories

- Over the next 2 years BER will transition from the current funding strategy to a format that funds research programs at the National Laboratories.
- Conforms with other major funding offices within the Office of Science.
- This format change takes advantage of team-oriented research for which the Labs are particularly well suited.

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BER Organized into Scientific Focus Areas (SFAs)

BER Scientific Focus Areas for National Laboratory Research

- Genomics: GTL – Biofuels
- Genomics: GTL – Bioenergy Research Centers
- Genomics: GTL Fundamental Science
- Ethical, Legal and Societal Issues
- Low Dose Radiation
- Medical Imaging Sciences
- Advanced Medical Instrumentation
- Human Subjects

→ Life & Medical Sciences Division

- Climate Change Forcing
- Climate Change Modeling
- Climate Change Response
- Climate Change Mitigation

→ Climate Science Division

- Integrated Environmental Remediation Field Studies
- Subsurface Science

→ Environmental Remediation Sciences Division

- Scientific User Facilities (ARMs, EMSL, JGI)*

*Elements within all three BER Divisions

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ERSD Scientific Focus Area (SFA) Program

Development of ERSD Programs at the National Labs

- ERSD is well ahead of the larger BER on this change.
- The structure of ERSD research is much less complicated than the other BER divisions.
- Three SFAs:
  - ***Scientific User Facility***
  - ***Integrated Environmental Remediation Field Studies***
  - ***Subsurface Science***
- We asked the Labs to review their ERSD portfolios and prepare integrative program plans that align with ERSD goals.

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Development of Research Plans at the National Laboratories

Long Term PART measure

By 2015, provide sufficient scientific understanding such that DOE sites would be able to incorporate coupled physical, chemical and biological processes into decision making for environmental remediation and long-term stewardship

ERSD Strategic Plan and Goals

1. *Understand and Predict Contaminant Fate and Transport*
2. *Subsurface Remediation and Long-Term Stewardship*
3. *Measurement and Monitoring*

Research Program Focus

Subsurface Contamination

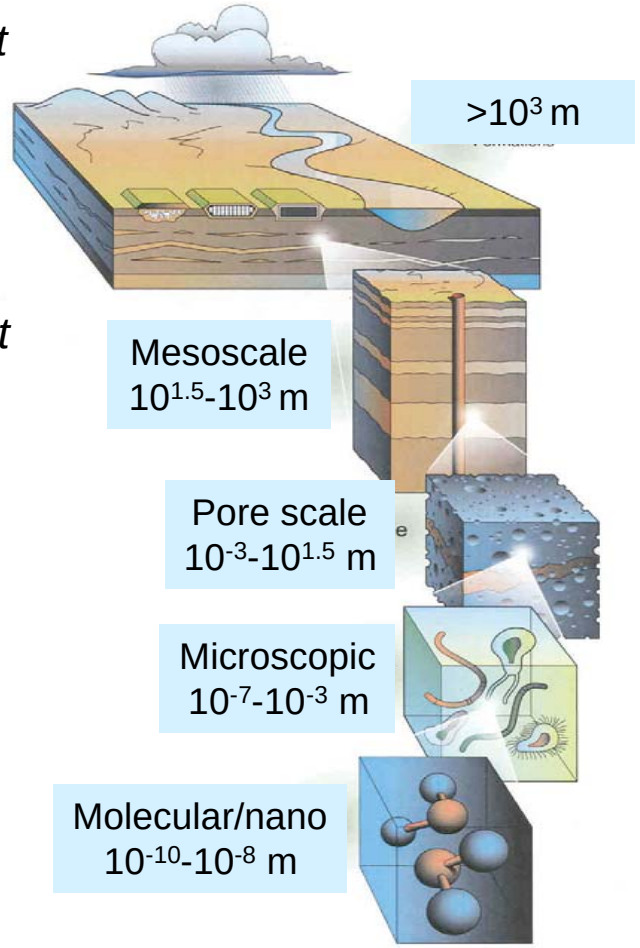
- *vadose zone and saturated zone contamination*
- *technically challenging problems with no clear solutions*

Contaminants of Interest

U, Tc-99, Pu, Np-237, I-129, Sr-90, Cs-137, Cr, Hg,

Co-Contaminants:

- *Nitrate and complexing agents*



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Scientific Focus Areas at the National Laboratories (FY09)

Funding Amounts for SFA Programs

- Funding amounts based on last three years of peer–reviewed research funded from ERSD.
- Total amount of funding for Lab-led projects in Subsurface Science is about $18M.
- The University-led component of ERSP is also, approximately $18M.

Initial ERSD National Laboratory SFA Research Programs

Pacific Northwest National Laboratory ~$6.5M
Lawrence Berkeley National Laboratory ~$4.5M
Oak Ridge National Laboratory ~$3.0M
Argonne National Laboratory ~$1.5M
Los Alamos National Laboratory ~$1.2M
Idaho National Laboratory ~$1.2M
Stanford Linear Accelerator Center ~$0.7M

Figures based on Lab-led peer-reviewed research including external collaborators

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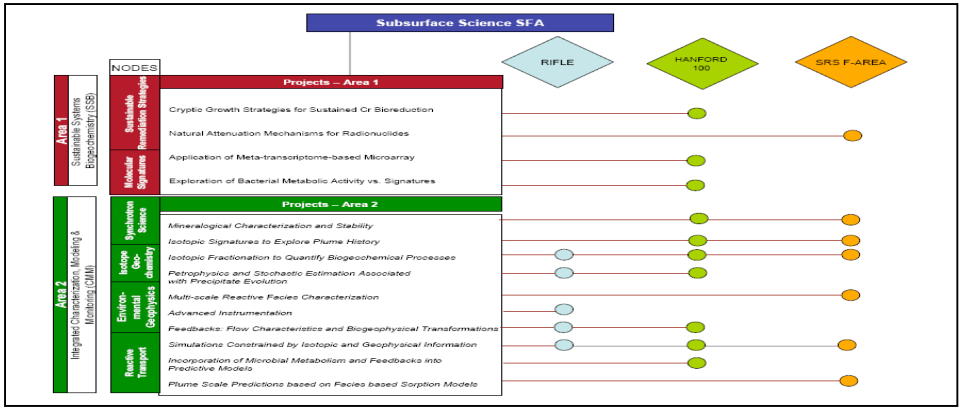
Lawrence Berkeley National Laboratory (LBNL)

(S. Hubbard, Research Manager)

Addressing Critical Knowledge Gaps Associated with Environmental Remediation of Metals and Radionuclides

Scientific Research Areas

- Sustainable Systems Biogeochemistry
  - **i. Sustainable remediation strategies** – understanding processes relevant to sustainable engineered remediation and natural attenuation of subsurface **Cr**, **U**, **I-129**, and **Sr-90** contaminants.
  - **ii. Molecular signatures** – facilitate discovery of genes that are associated with bioremediation-relevant microbial activities, create a high-throughput approach to assess the *in-situ* expression of these genes, and determine whether there are reliable quantitative correlations between key genes (i.e., their presence or expression) and bioremediation-relevant metabolic activity.
- Integrated Characterization, Modeling and Monitoring
  - **i. Synchrotron Science** – molecular scale processes influencing contaminant transport
  - **ii. Isotope geochemistry** – tracking the fate of fluids and contaminants in the subsurface
  - **iii. Environmental geophysics** – integrating geophysical and hydrological data
  - **iv. Reactive transport modeling**



Field Site Coordination

- **F Area at Savannah River Site in collaboration with SRNL.**
- **Rifle IFC site in Rifle, CO**
- **Hanford 100H and 100D Areas**

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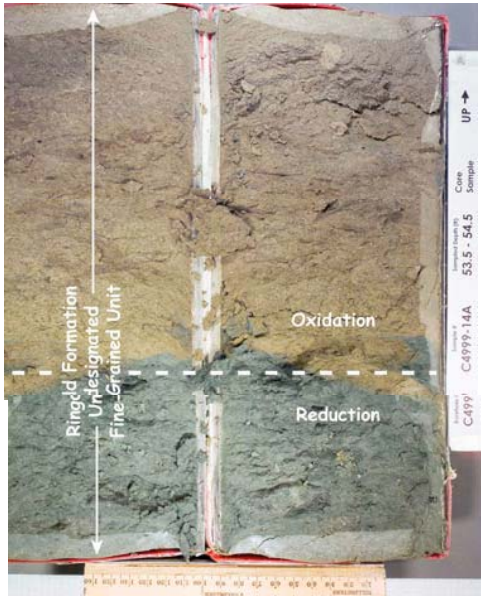
Pacific Northwest National Laboratory (PNNL)

(H. Bolton, Research Manager, J. Zachara and J. Fredrickson, Chief Scientists)

Role of Microenvironments and Transition Zones in Subsurface Reactive Contaminant Transport

Objective: ***Resolve critical Hanford and basic subsurface science issues through integrated, multi-disciplinary research on the role of microenvironments and transition zones in the reactive transport of Tc, U and Pu.***



Goals:

- **Conceptual model of microbial ecology for the Hanford subsurface.**
- **A fundamental understanding of processes affecting contaminant transport in microenvironments and transition zones.**
- **Reactive transport models for Tc, U, and Pu that integrate multi-process coupling at different spatial scales for field-scale application.**

Eleven projects in six groups around increasing scales of observation

SFA projects (principal Co-PIs)*:

i.) microbial ecology
ii.) molecular scale mechanisms
iii.) pore-scale coupled processes
iv.) reactive transport science
v.) multi-scale reactive transport models
vi.) in-situ structures and reactive transport properties

Funded external Collaborators at:
LANL, USGS, Stanford Univ., ANL, Univ. Colo., Georgia Tech, ORNL, Univ. East Anglia, Univ. Wisc., Oregon St. Univ.

Well Integrated with Field Scale studies at the Hanford IFC

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Oak Ridge National Laboratory (ORNL)

(L. Liang, Research manager)

Understanding the geochemical and microbial transformations of U and Hg in systems subject to groundwater-surface water exchanges

Mercury

1. Elucidate the rates, mechanisms and controls of abiotic and microbial processes affecting Hg speciation and transformation, and resolve how and what critical Hg precursors are produced, transported and subsequently methylated in the ecosystem.
2. Develop and validate models to understand in detail the biochemical and biophysical mechanisms of transformation between major Hg species and MeHg.

Uranium

1. Determine whether bacterial iron oxidizers play significant roles in the oxidation of U minerals under environmentally relevant conditions.
2. Identify the structure and functional physical mechanism of key proteins involved in direct electron transfer and to elucidate the molecular mechanisms involved in microbial metal reduction.

Field Site Coordination

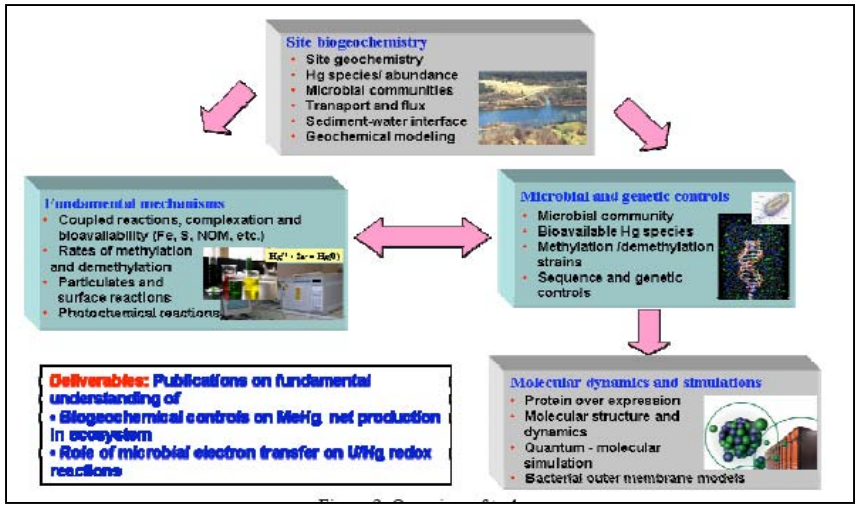
-Oak Ridge Y-12 East Fork Poplar Creek

-Oak Ridge IFC

Environmental Applications of neutron science at the Spallation Neutron Source (SNS)

<u>*Funded external collaborators at:*</u>

PNNL, ANL, Univ. Tenn/Knox, Tenn. Tech. Univ., Univ. Delaware, Univ. Georgia, Smithsonian Inst., Univ. Mo.



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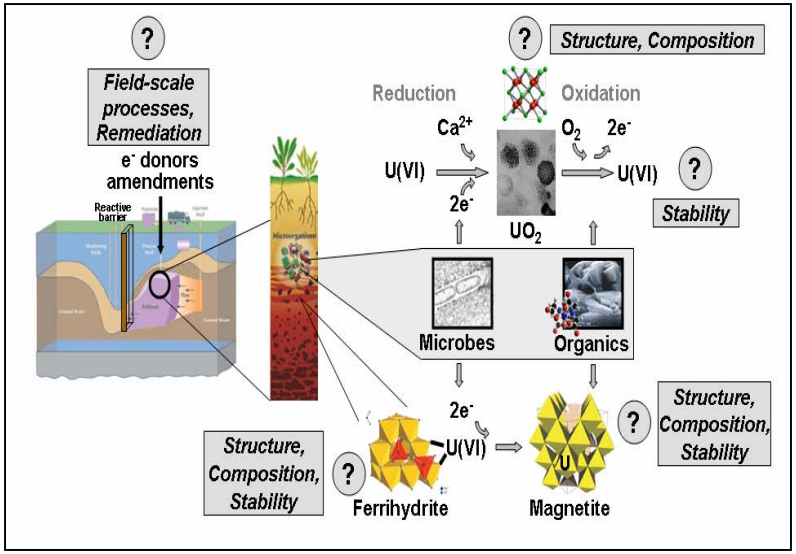
Stanford Linear Accelerator Center (SLAC)

(J. Bargar, Research manager)

The chemical dynamics and stability of complex environmental solid phases (UO2, PuO2, and Fe(II,III)(hydr-)oxides), and their capacities to perform as long-term sinks for U and Pu.

Collaborative, synchrotron-based science addressing:

- Molecular-scale structure, dynamics, and environmental stability of bacteriogenic UO2 and other U(IV) products.
- Molecular-scale structure, dynamics, and U(VI) binding mechanisms of environmental Fe(II,III) (hydro-)oxides
- Molecular mechanisms of Pu binding by environmental solids
- Contaminant speciation for site characterization, remediation, and closure, and repository performance assessment.



Collaborations:

R. Bernier-Latmani (EPFL), H. Boukhalfa (LANL), G.E. Brown, Jr. (Stanford Univ.), D.L. Clark (LANL), J.A. Davis (USGS), P. Eng (U. Chicago), S. Fendorf (Stanford Univ.), C.C. Fuller (USGS), D. Giammar (WUStL), K. Maher (Stanford Univ.), A. Mehta (SSRL), E. Pierce (PNNL), P. Reimus (LANL), L. Soderholm (ANL), and D. Wellman (PNNL)

Funded external collaborators at:
Ecole Polytechnique Fédérale de Lausanne, Washington Univ.

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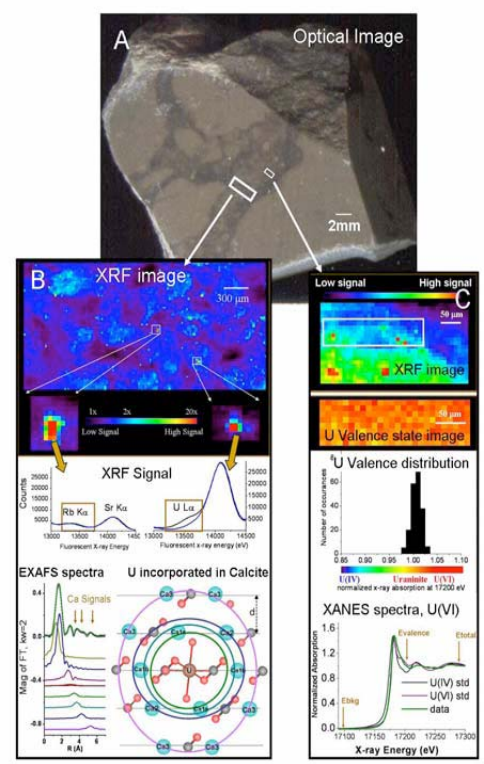
Argonne National Laboratory (ANL)

(C. Giometti, Research manager, K. Kemner Research coordinator)

Microbial metabolic activity and changes in solution chemistry, mineralogy, and solid-phase surface reactivity, affects the distribution of (bio)mineral phases, as well as the rate, extent, and mechanisms of contaminant transformation.



Synchrotron-based Biogeochemistry

Goals

- Determine which aspects of microbial physiology, solution chemistry, and mineralogy are key to the distribution of mineral species and to contaminant transformations.
- Evaluate the reactivity of reactive biogenic mineral phases with respect to the chemical transformation of **U** and **Hg**.

Integrating synchrotron science with geochemistry and molecular biology

Funded external collaborators at:
Illinois Inst. Tech., Northeastern Univ, Univ. Iowa, Univ. Sofia, Hamilton Coll., UIUC, Mich. State Univ., Stanford Univ.

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Los Alamos National Laboratory (LANL)

(M. Ebbinger, LANL POC)

(PIs: H. Boukhalfa, Y. Duan, A. Fattah, P.Lichtner, D. Reed, P. Reimus, R. Roback)

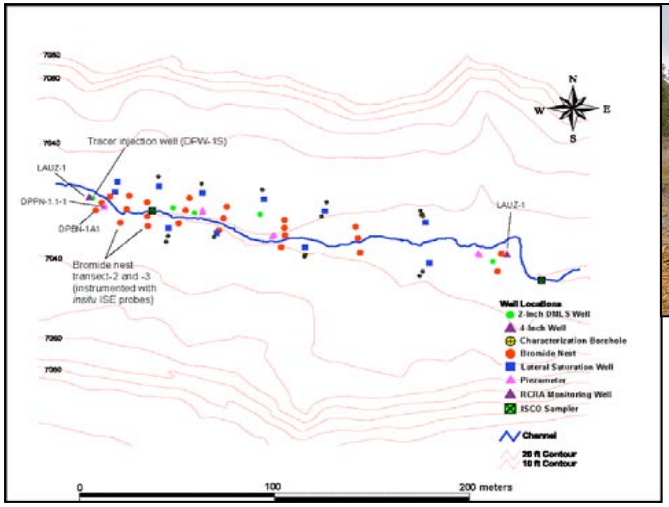
Biogeochemical Processes Influencing Colloid Facilitated Mobility of Actinides (Pu, Np) in Subsurface Environments

Goals

- Demonstrate the physical and biogeochemical processes and site-specific conditions that influence Pu/actinide solubility and/or colloid formation
- Identify the critical processes influence Pu/actinide mobility
- Improve accuracy of general and site-specific modeling parameters to improve defensibility of fate and transport predictions and to provide scientific basis to choose among remediation alternative and long-term stewardship options.

Combination of lab and field-based studies to understand the formation and mobility of Pu colloids.

-Science focus draws on the results from the Rocky Flats site and recent high profile publications on Pu mobility (e.g. Mayak facility).



Potential field testing site at the DP Canyon Reach 2

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Idaho National Laboratory (INL)

(M. Ankeny, Research manager)

Subsurface Immobilization of Metal Contaminants by Amendment-Driven Mineral Precipitation

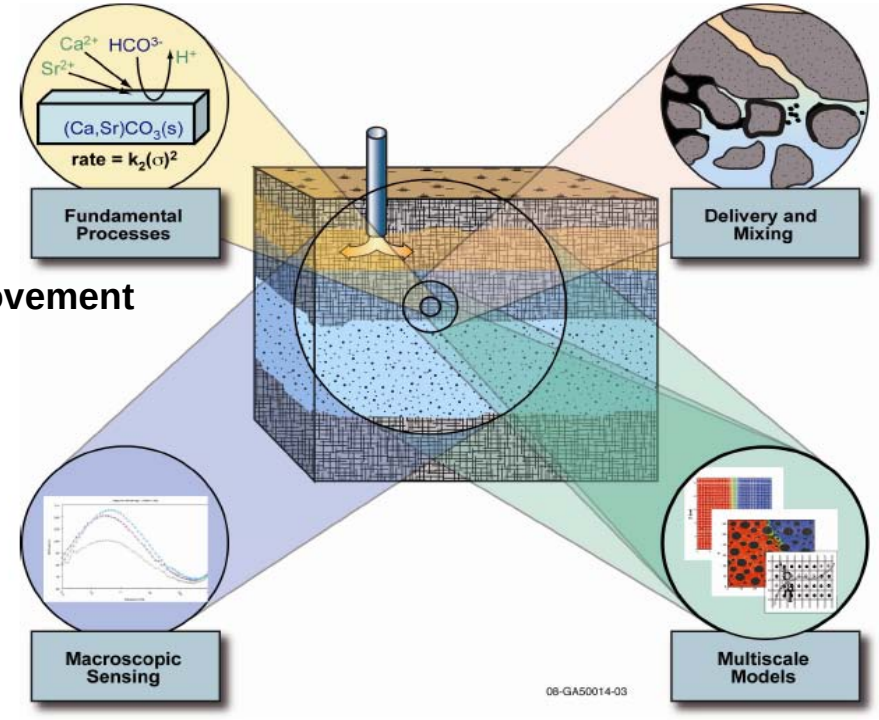
Goal:

Resolve critical gaps in the scientific basis required for the successful development and field-scale application of in situ immobilization techniques for remediation of deep subsurface metal and radionuclide contamination across the DOE complex, including the 90Sr contamination under the INL INTEC facilitv.

Two General Hypotheses evaluated Within four Research Elements:

- **Transport/Precipitation coupling in porous media**
- **Fundamental processes and parameters**
- **Multiscale model application, validation and improvement**
- **Sensing methods**

Direct and thematic connections with Sr-90 ERSP projects, SciDAC, and IFC Efforts within ERSD.



Funded External Collaborators at:
PNNL, Univ. Idaho,
Washington St. Univ.,Rutgers Univ.

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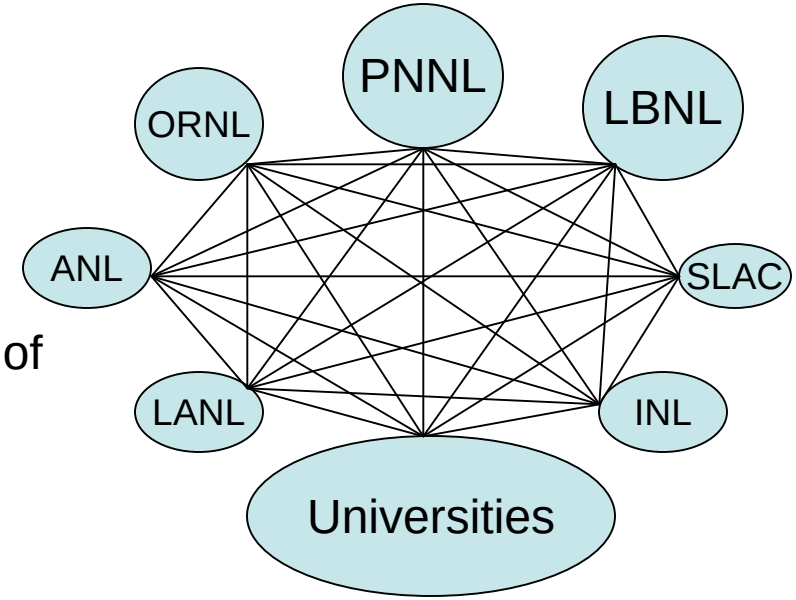
The Opportunity

Shaping the ERSP

- ERSP still in transition from NABIR and EMSP.
- The new funding format for the Labs focusing on team-oriented science over 5+ year timescale provides an opportunity to bring more structure to the Lab-led efforts in the ERSP.
- More consistent with overall operations at National Laboratories.
- Identified gaps in the Lab programs can be incorporated as part of the general ERSP solicitations.

Benefits of a more Structured Program

- Easier to communicate a holistic view of the science within the ERSP.
- Bring a more dynamic character to the ERSP Notices.
- Allow to clarify the relevance and importance of new initiatives in the context of the existing program.



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Challenges

Review and Management

- The new format will change the way ERSD interacts with the Labs.
- With this new format the direct day to day management responsibilities rests with the Labs. ERSD will be responsible for oversight and review.
- Future Lab reviews on progress must be rigorous and have real consequences.
- ERSD is still very much in the initial planning stages of how to hold Labs accountable for their performance.
- The review tomorrow is a good start and will focus not only on scientific and technical merit but also whether these plans constitute unique team-oriented programs.
- Going forward ERSD needs to:
  - establish clear overall expectations for the Labs
  - set review criteria, format and review timing
  - set review consequences
  - be as transparent as possible about the process

A Work in Progress

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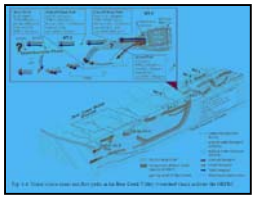
ERSP Structural Outlook (FY2009)

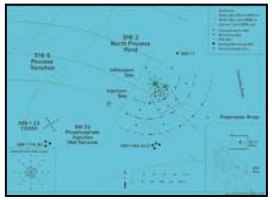
Long Term Measure

Field Scale Research

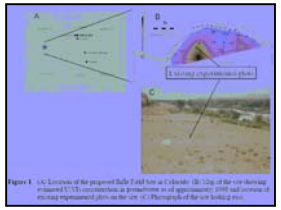
Oak Ridge Y-12



Hanford 300 Area



Rifle UMTRA site



Smaller and fundamental scales

Increasing Complexity & Increasing Field Relevance

Computational Modeling & Iterative Experimentation

PNNL

ORNL

LBNL

ANL

SLAC

LANL

INL

Universities